Middlebury Union High School
Food Waste Recovery Initiative

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Fall 2017
Environmental Studies 401B

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Project Overview

Project Description:

Why don't high schoolers recycle their food waste? Vermont's Universal Recycling Law (Act 148) passed in 2012 is being phased in with full compliance of the law in effect for all households and institutions by 2020. To be in compliance with the law all schools in Vermont must have an effective food waste recycling program in place. To consider how this law impacts the local Middlebury Union High School (MUHS) our project group worked with representatives from the school and the Addison County Solid Waste Management District (ACWSMD) to investigate why the existing food waste recycling program has only been moderately successful. We used survey results from a high school student questionnaire administered by the 401 program in partnership with the high school in June 2017. The survey measured awareness, interest and attitude towards food waste and recycling overall. These results provide a benchmark but only tell part of the story. In practice the High School food waste program simply does not work. What should be done? Are there incentives? Do the current systems in place at the high school encourage or discourage a behavior change? The primary partners will be Don Maglienti from the ACSWMD and Kerianne Severy from MUHS.

Project Goals

I. Identify barriers to implementation of food sorting systems in schools in the area, and assess strategies to overcome them.
    A. It is important to work with those affected by the issues at hand and hear directly from those most closely involved with the project in order to reach the best solution. We believe that the success of this project depends on integration of concerned parties into all aspects of the process rather than to come at the issue solely from a top down approach.

II. Provide lasting infrastructure and education to encourage behavior change beyond the scope of this project.
    A. Our suggested improvements should have lasting beneficial effects on the school's waste management system and provide tools for continued staff, faculty, and student engagement.

Introduction

Act 148, Vermont's Universal Recycling Law, was passed in 2012 in an effort to increase diversion rates of solid waste into recycling programs. The diversion rate has remained flat for more than 10 years at ~30%, so the law looks to continue to reduce the waste that goes into landfills, which are some of the largest sources of greenhouse gases (Vermont Department of Environmental Conservation 2016). This law requires that Vermonters divert all compost and recycling from landfills as much of what it currently placed in landfills could be diverted and given another use (Vermont Department of Environmental Conservation, 2016). The law prioritizes alternative food waste options, encouraging donation, composting, feeding livestock and converting to energy with the goal of reconceptualizing excess food as waste to a mindset that sees it as a resource (Hochreiter, 2016). The restructuring of the waste system through Act 148 is being implemented in stages. Initially, the law applied only to large producers of waste, but smaller producers are being phased in year by year, requiring proper sorting of trash, recyclables and compostables down to the household level.

Middlebury Union High School will need to be in compliance with Act 148 by July 2020. Waste stream contamination in the context of this project refers to compostable food scraps and blue-bin recyclable products entering the High School's landfill waste stream. Consequently, all recyclables and food scraps produced and disposed of by the school will have to be properly sorted and leave the school free of cross- contamination between trash, recycling and food scraps.

On a larger scale, the diversion of food scraps from landfills is important in reducing the methane emissions produced by Vermont. The environmental impact of food waste is of a high magnitude; "if global food waste was a country, its carbon footprint would rank third, behind only China and the U.S." (Food and Agriculture Organization, 2013). Greenhouse gas emissions resulting from the decomposition of organic wastes such as food scraps in landfills are a contributing factor to climate change. In landfills, the decomposition of food, the single largest component of municipal solid waste reaching our landfills in the United States, accounts for 23% of all methane production in the country (Gunders, 2012). The anaerobic decomposition that happens when organic materials are placed into landfills produces the methane, a greenhouse gas with an effect approximately 25 times stronger than carbon dioxide (CalRecycle, 2013). Their organic nature and high moisture content causes food scraps to decompose faster than other material in the landfills. As a result of the rapid decomposition, the methane is often released before landfills are capped, directly releasing it into the atmosphere without any opportunity for capture (Gunders, 2012). Diverting the materials that are a primary source of methane production would work to reduce the harmful environmental effects of the landfills.

In 2015, municipal landfills accounted for 15.4% of methane emissions in the United States placing it as the third-largest source of human-related methane emissions in this country (Basic Information about Landfill Gas, 2017). The methane coming off of

landfills can be used in a more productive manner in that it can be fed into a methane digester to produce energy from its combustion to CO2; however this is difficult as most methane is released when the landfill is uncapped and the gases are less controlled. When food scraps are sent to a composting facility with an anaerobic digester, the methane produced through decomposition can be trapped and burned to release carbon dioxide, a less harmful greenhouse gases, as well as providing a source of renewable energy. As a result, the diversion of food scraps from landfills can be one step towards combating our emissions and fighting climate change. Another benefit to diverting all waste from landfills, is the slower rate at which new landfills will be needed. Fewer new spaces will have to be designated waste zones thus reducing other harmful impacts from waste including water and other air quality impacts. Vermont only has one operational landfill in Coventry and reducing the volume of waste sent there would delay the need for expansion (Lindholm and Lucey, 2015).

By setting up an effective waste sorting system at the high school to make it easy for the students to prevent contamination, we hope to use this as an opportunity for education to encourage long-term behavior changes that go beyond students' time at the high school and influence the behavior of their peers and families.

Methods

Survey

In preparation for this project, a survey was sent by the 401 program and the ACSWMD to students at MUHS in May 2017 to determine their composting and recycling habits as well as assess their knowledge of proper waste disposal practices (See Appendix A). This survey was voluntary; 160 responses were received representing 25.6% of the student population. The results showed most students who took the survey knew which waste items belonged in the landfill, recycling, or compost and many students at MUHS recycle and compost at home, 90% and 55% respectively. When presented with an apple core, 86.59% of students were aware that it went in the compost and 73.01% responded that food scraps in general are also compostable. For snack bar wrappers and chip bags, 95.63% and 93.90% of students respectively indicated that they know this item is trash. For recyclables, 82.72% appropriately understood that yogurt containers go in the recycling while 96.94% and 96.28% knew to put plastic bottles and soda cans in the recycling. A small portion of the questions led to varied responses, specifically drink boxes and to-go containers showing that some clarification or additional education may be necessary to achieve lower contamination rates. However, overall these results demonstrated that a strong majority of students at the high school are aware of how to correctly dispose of their waste.

Figure 1: Main waste sorting station in MUHS cafeteria as of Fall 2017

Although the students appear to have understand what is recyclable and what is not, according to survey results, MUHS still has a significant issue with waste stream contamination. In an attempt to address this, the survey also evaluated student opinion on the clarity of the current system. When given an image of the bins in the cafeteria now, 57.67% of student responses demonstrated confusion between the different bins and what to place where. Each bin received responses for trash, recycling and food scraps suggesting the amount of contamination could be significant if the current system proceeded unchanged. The

evidence collected by this survey suggests that the contamination issue at the high school is less due to a lack of education on waste disposal, and more as a result of the setup of their disposal station and a necessity for behavior change.

Behavior Change

The concept of the behavior change wheel (BCW), developed by Michie et. al 2011, is helpful in understanding the issue at hand in the high school (Figure 2). At the core of this theory are three essential conditions that form a new model of behavioral change: capability, opportunity, and motivation. These three conditions together represent effective change (Michie et. al, 2011). Through this lens, different styles of intervention are suited to meet specific situations hindering the success of each condition.

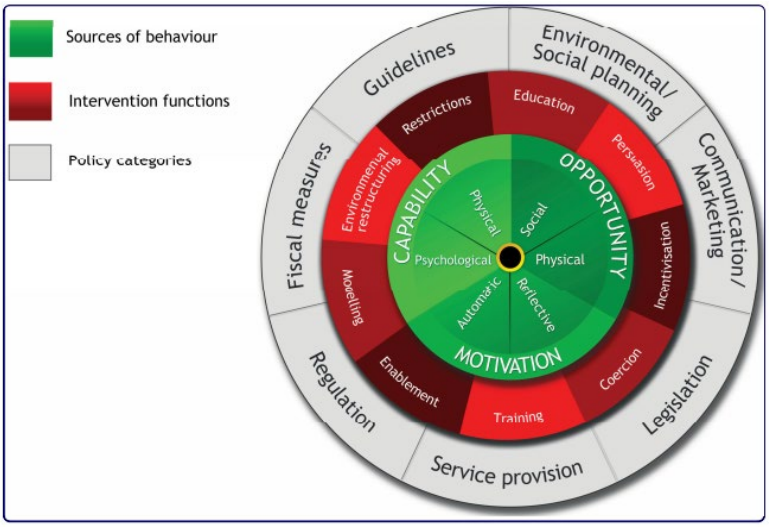

Figure 2: Behavior Change Wheel (Michie et. al, 2011).

Students at MUHS have shown they have some capability to compost food scraps. Therefore, this project is focused on promoting increased physical capability through environmental restructuring and increasing opportunities through education. The environmental restructuring includes increased access to proper sorting stations by placing bins at various high traffic points in the food areas. The education goals include providing compelling motivation through training to enable and encourage students to act and take ownership of their waste system.

Jac Hochreiter, the former public outreach coordinator for the Addison County Solid Waste Management District (ACSWMD), gave a presentation to the class about the positive impacts of clearly marked side by side bins can have on the contamination problem in many places. Studies conducted previously have found that if the bins are together and clearly labeled with information about what goes in each bin, the laziness that can come with separating waste is alleviated; it needs to take no more effort to recycle something than it does to throw that same item in the landfill bin (Hochreiter, Pease, & Cheek, "A Trillium Ways to Waste" 2014).

Choice Architecture

The theory behind choice architecture, which refers to the organization of the contexts in which people make decisions, provides a number of useful insights into the problems with the waste sorting system currently in place at the high school. Fortunately, it also provides ideas as to how its performance could be improved.

In choice architecture, the importance of what are known as "defaults" cannot be overstated. A default in this framework refers to the option or outcome that a person will settle on, given an array of options to choose from, if they put the least amount of effort possible into making their choice. This idea can also be thought of as the "path of least resistance" for the chooser (Thaler et. al, 2012).

In the physical design of the waste sorting stations at the high school, the bin for landfill waste has become the default option. When students with food scraps on their plates round the corner to approach the main waste sorting station in the cafeteria, the first bin they encounter is the landfill waste bin. The path of least resistance in this case is to dump all waste into this bin meant strictly for landfill waste. As Figure 1 shows, the current waste sorting stations do include bins for recyclables and food scraps. However, the labels on these bins denoting the types of waste they are meant for are difficult to read. And, many of the non-landfill waste bins have lids that make them difficult to use.

This issue is compounded by the fact that all of the bins–with the exception of the green compost bin on the far left-hand side–are the same shade of blue. In addition, each of these blue bins is emblazoned with the universal "arrow-triangle" symbol for recycling (See Figure 1). This serves only to reinforce in the mind of the user that their choice of bin does not matter, as all the bins are virtually identical in appearance. Thus, the user is almost *encouraged* to simply throw everything into the "default" landfill bin on the end and get on with their day.

Fortunately, choice architecture suggests some ways in which flawed systems such as this one can be fixed. As we attempt to radically redesign the high school's waste sorting stations, we will be following the principle of mandated choice. Mandated or required choice refers to the minimization of default options in a choice system's physical design, in effect forcing users to put effort into making decisions as opposed to settling for the path of least resistance (Thaler et. al, 2012).

Stakeholders

While the primary stakeholder in this project is MUHS, it will have implications across the district and the state.

The administration at MUHS has a stake in this project because of Act 148. They have until 2020 to divert all of their food scraps from the landfill; if they do not comply, they could be faced with fines from the state and from their haulers for every day on noncompliance. This project will hopefully encourage students to properly sort out their food scraps, which will protect the school from the repercussions of Act 148 down the road.

The same will hold true for all of the schools in the Addison County School District. Therefore, if MUHS can be a part of setting a standard for methods in which food scraps can effectively be diverted, the process put in place by this project can be applied to the the rest of the school in the district.

Finally, the ACSWMD holds a stake in the success of this project. As they provided much of the funding for this project, they are actively promoting the diversion of food scraps from Vermont landfills. As they are able to get more schools on board with food scrap diversion, they will also be reaching more students who can take what they learn in school and apply their knowledge at home and in their communities. Additionally, as they encourage more people to divert their food scraps, they will be reducing the effects of the methane from the landfill on the lives of Vermonters.

Within MUHS there were individuals who helped make this work possible. The first was Kerianne Severy, the Student Senate Advisor and a math teacher. Mrs. Severy saw the need for a better system in MUHS and agreed to be the key stakeholder to take on this project from the school's side, acting as a crucial bridge between us and the administration. She ensured that our goals and implementation plans were logistically possible and garnered the support from the school as it was needed. Her role as liaison was invaluable; she served as a true "champion".

Bruce MacIntire is the head of facilities for the Addison County School district. Since his staff is charged with emptying the waste bins, they are accountable by the haulers for keeping the waste separated and in the school district in compliance with Act 148. Our conversations with Bruce and custodian Sue Herring allowed us to brainstorm the best materials needed for the sorting stations, and the best placement to ensure we did not hinder the duties of the custodial team. Bruce was integral to the school district's eligibility to receive the ACSWMD grant (see page 7), as his budget provided the matching funds required to access the grant money.

Another critical "player" in this process was the student body of MUHS. The success or failure of the new system rests solely on their shoulders. It is up to each individual student to care enough to sort their waste properly in order to keep the school in compliance with act 148. While we can provide this new and improved system, it is not successful if the students do not participate. Students were also very helpful in our process. We were able to gather student opinions of the current sorting stations and

through the Student Senate we were able to test our plan for the redesign. One student in particular, a freshman named Griffin, was highly motivated to work with us. Griffin was always willing to help, and gave us a lot of background information including the current attitudes of the students, where the storting stations would most conveniently be placed for the students, and how to encourage student involvement at our education events.

Science teachers at the school, especially Linnea Manley, were also incredibly helpful in this process. Her stake in this project rests with the education and in particular the curricula opportunities. . She is teaching a waste stream management unit as part of the AP Environmental Science AP course in the spring, Ms. Manley was a great support of this work, , and offered her students extra credit for attending the Trash on the Lawn Day (See Education Initiatives). Ms. Manley also committed to keep the conversation about waste active by continuing on with this topic in her AP Environmental Science class in the spring.

Finally, teachers outside of the high school were great resources to us in our process. Katie Moquin, the head of the Compost Club at Middlebury Union Middle School (MUMS), is a lead agent in the waste sorting process at the middle school. We modeled our system after the one she had already created at MUMS. She helped us with the grant writing process. She gave us her cost lists which informed the materials we chose and answered many questions about the system design. As head of the compost club, she has also influenced a large group of middle school students who we hope will continue this interest once they reach the high school. Incoming students who are already used to this same sorting system almost guarantees success!

Implementation Initiatives

Based on information gathered in a survey of MUHS students in May 2017 and through discussions with members of the school and waste management communities, we have developed a plan for short term actions within the high school that we hope will pave the way for long term changes. We determined that although the problem at hand was complicated, there was a simple solution. The intention of this work includes the implementation of new bins in conjunction with educational posters and events to encourage students at MUHS going forward to properly use the food scraps collection program. With their participation, this effort will reduce food scraps thrown in the trash as well as contamination found in the food scraps bin.

Our implementation plan includes introducing new bins in the school that are clearly labeled to increase the convenience of food scrap collection. Educational posters answer questions and lay out a program to decrease contamination rates. To implement this plan we coordinated with MUHS to apply for a grant offered by ACSWMD to purchase the materials necessary to design and purchase the new bins and waste collection system. ACSWMD provided support with outreach and implementation in addition to guiding us with their expertise on the topic.

The School Diversion Grant

After gathering our base information, the first step towards implementation was applying for the School Diversion Grant through the ACSWMD. This grant was presented to us by our partners at the ACSWMD as a way to obtain funds for the physical implementation of a new system. Available as an allocation from the District budget, any school trying to make improvements to their waste sorting systems in order to divert more recyclables and/or food scraps from landfills can apply for funding. The grant would provide up to $2,000 to help the school improve its solid waste disposal system. While we originally believed the grant would cover the cost of the entire project, we learned when we met with Katie Moquin that it would only cover 75% of costs, as the recipient of the grant is expected to cover the remaining 25% local match. We received permission from the school to apply for this grant, as it was a great way to receive the funding we needed without straining the school budgets. We then were able to use the MUMS grant as an outline to produce cost estimates for each of our different sorting station design options. Our final asking amount was $1,400 to cover the construction and implementation of four sorting stations at the High School, 25% of which Bruce agreed to give us from his facilities budget. The ACSWMD board approved our application, which allowed us to move forward with our most expensive but best design for our stations. A copy of our grant application can be found in Appendix B.

Station Design

With the money from the School Diversion Grant we solidified the design for our sorting stations, using options that were determined to be the best both stylistically and practically by the administration, Bruce, and Sue. Our design was also based on the principles of choice architecture, as well as existing stations determined to be successful. Images of these stations can be found in Appendix C. We decided to go with three foot tall tables with pressure treated 4x4s for the legs and a two by six foot piece of chipboard as the initial top. On top of the chipboard we secured a laminate countertop, with a lip and backsplash included. We cut three holes in the top of each table two feet apart. Five gallon buckets that had the bottoms removed were inserted into the holes to act as chutes to funnel the waste into the proper bin. Below the table, we used chipboard to create dividers to keep the bins in their proper place and prevent waste from falling into the incorrect bin or onto the floor. We added wheels to all bins and tables to ensure they were mobile for the convenience of the custodial staff and the administration. (See Figure 3)

We used color-coded bins to make sorting even clearer for students, and each bin has one of the ACSWMD official labels explaining what type of waste belongs in that bin. The state of Vermont is attempting to make these labels universal to encourage continuity across the state to improve behavior of waste sorting. These labels are included in Appendix D.

We decided to label the bin for compostables "food scraps" in our design. We found that while many students knew to put raw fruits and veggies in the compost, they were having trouble remembering that prepared foods such as pizza and french fries could be added as well. The term "food scraps" will hopefully be a more inclusive term referring to all food and lead to a greater amount of compostable material being thrown in the proper bin.

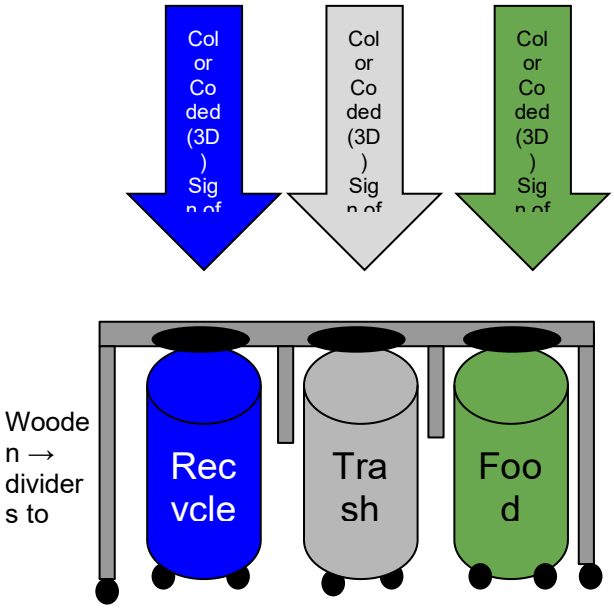

Figure 3: Station design

We set up the bins intentionally with trash in the middle and recycling and food scraps on either side. When we visited the high school we noticed that at the main sorting stations the trash bins were the closest to where the students dropped off their trays. This resulted in many students dumping all of their waste into the trash bin since it was the simplest action to take rather than sorting it. We are hoping that by placing the trash in the middle and forcing the

students to pass by the food scraps bin in order to get to it they will be more willing to sort the food scraps out from their trash.

The sorting stations will be placed at four strategic locations by the two main eating areas as shown by the map in Figure 4. The two sorting stations in the cafeteria will remain in the spots where there currently are waste disposal stations. These spots are in high traffic areas while also not obstructing the movement through the cafeteria. Additionally, we will place two sorting stations in The Commons, a space frequented during lunch by upperclassmen and the current location of one sorting station, one at each end of the space which will increase the convenience for students passing through or leaving the area. Currently, there is one station under the windows facing the courtyard. This location is further from the main student traffic and does not capture the waste from students passing through the area. These stations aim to reduce the food scraps that end up in trash bins present in the hallways away from the cafeteria, shown in the example pictures in Appendix E. There are no options for food waste disposal once the students move away from the eating areas so it is imperative that the new sorting systems are convenient and capture the food scraps from students as they move to their next class. A map with locations of the new sorting stations is depicted in Figure 4.

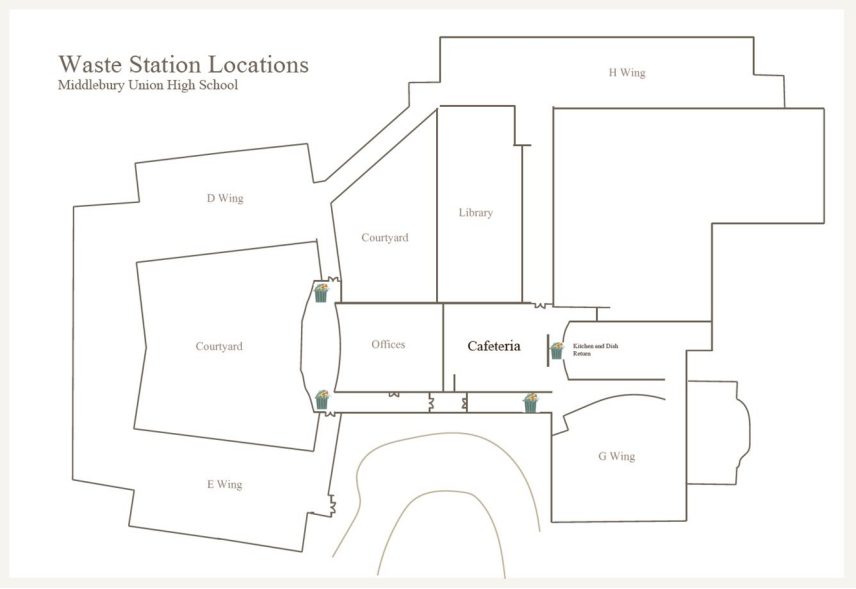

Figure 4: Map of locations of waste sorting stations at MUHS. Each station includes a sorting table with three bins (trash, recycling, food scraps), and is depicted by a trash can.

Education Initiatives

Trash on the Lawn

Our second main initiative in this project was the organization and execution of a Trash on the Lawn Day at MUHS. This involved us saving trash from the day before the event, but keeping it separated by what was thrown in the trash, recycling, and compost bins in the popular lunch locations. We decided to organize this day due to past successful involvement with this type of event. Trash on the Lawn days had proven to be successful through the experiences of our ACSWMD parter Don Maglienti and our group members. Our goal was to provide the students with hands on experience facing the reality of their waste contamination, and to encourage them to rethink their waste sorting habits. While our limited publicity only convinced about 15 students to participate, those students walked away from the event with new knowledge about how to sort their waste and the confidence to pass the knowledge along to their peers. A template for future Trash on the Lawn events in included in Appendix F, and our process is described below.

We first weighed the waste in each of the three categories (trash, recycling, food scraps). We then dumped it onto a tarp, beginning with all of the material found in the compost and recycling bins. The waste found in these bags was sorted into the categories in which it actually belonged, and then was weighed again to see how much contamination was present. We then repeated this process with the material found in the trash bin. There were significantly more bags of "trash" than of anything else. However, as each bag contained some contamination from other types of waste, it was our job to sort out the contamination into the proper buckets, and then again weigh each category to see the amount of contamination present in each bin (See Figure 5).

Without a lot of notice we were not able to publicize the event adequately, but details were announced in the morning announcements to all of the students, and were put on the screens that run announcements throughout each lunch period in the cafeteria leading up to the event. We were not able to hold the event on the front lawn of the school due to weather, but on the sidewalk in the front of the school. It took us about a week to get a location and date approved for the event, and four days to plan and execute. We held the event during the three lunch periods, which run from 11:30am to 1:30pm. We were relatively visible at this location, which was protected from the wind, thus preventing the trash from being blown across the school grounds.

We could not have put on this event without help from the ACSWMD, specifically from Don Maglienti. Having done this in the past, he knew exactly what needed to be done and showed up with all of the materials we needed, and even some we did not know that we needed. He brought us a large tarp, fifteen five gallon buckets to sort the waste into, fresh garbage bags, a scale, gloves, and trash pickers. We also had tremendous help from Mrs. Severy, who worked to get the whole event approved for us, and Sue Herring, who made sure the waste was separated and saved for us from the day before.

When went to the school on a Thursday to finalize details about this event, we planned it for the following Tuesday. The students did not have school on that Friday, so it only gave us one full day and one morning of promotion before the event. Since this was such a short time frame, we had to include other methods to get students involved. We used the Student Senate and personal friends within the school to promote it to their peers and encourage them to come out. Science teachers announced it to many of their classes, and some, including Ms. Manley, gave extra credit to students who participated. Finally, we held a raffle at the event to try and encourage a better turn out. We allowed each student to fill out a raffle ticket for every lunch period they participated, and in the end we drew a name to win a candy-filled water bottle as a prize.

Figure 5: Project group sorting through trash with students at MUHS Trash on the Lawn day

Overall, the day was a success. We had about 20 students come out to see what we were doing, and around 15 of them stayed to help us sort. While students came and went throughout the event, two came out during all three lunch periods, and Griffin was out with us the entire time. While many students were hung up on the "ick" factor of sorting through a pile of trash, Griffin dove right in; he used his hands instead of the trash pickers and was willing to scoop all of the leftover compost into the proper bucket with his hands while others used a shovel. He made an in-person announcement to the lunch room at the beginning of the period, and assisted us in set-up, sorting, weighing, and take-down. Deservingly, he won the raffle for the water bottle.

When we received the trash for the sort, unfortunately the bags containing waste from the recycling and compost had been combined into one large bin, making it difficult to tell which bags belonged to each category. This led to some confusion with the separation of each category, and in the end we were not able to determine contamination data for those categories separately. However, we were able to obtain a good baseline of data for the contamination present in the trash bins, which the school will be able to work off from with future trash sorts after the implementation of the new sorting stations (See Figure 6).

In total, there was 42.2 lbs of waste from the trash bins to sort through at Trash on the Lawn day. Of all of the waste put into the bin, only 20.6lbs were items that belonged in the trash bin. Only 4.4 lbs made up misplaced recyclables, however food waste constituted 17.2 lbs of the waste. This allowed us to discover that while students for the most part knew where their recyclables should be going, they either did not know or did not put in the effort to compost most of their food scraps; there was more food sorted out of the trash bins than the recycling and foods scraps bins combined (See Figure 6). We also noticed that most of the food found in the trash bin was greasy foods, such as pizza and french fries, that would not go into a home composting system versus the commercial composting site where the MUHS waste is processed. This may have been simply a point of confusion for the students, since there was no clear signage describing what could go into the food scraps bin. This informed our decision to add greasy foods served in the cafeteria to our food scraps posters that hang over each of the food scraps bins.

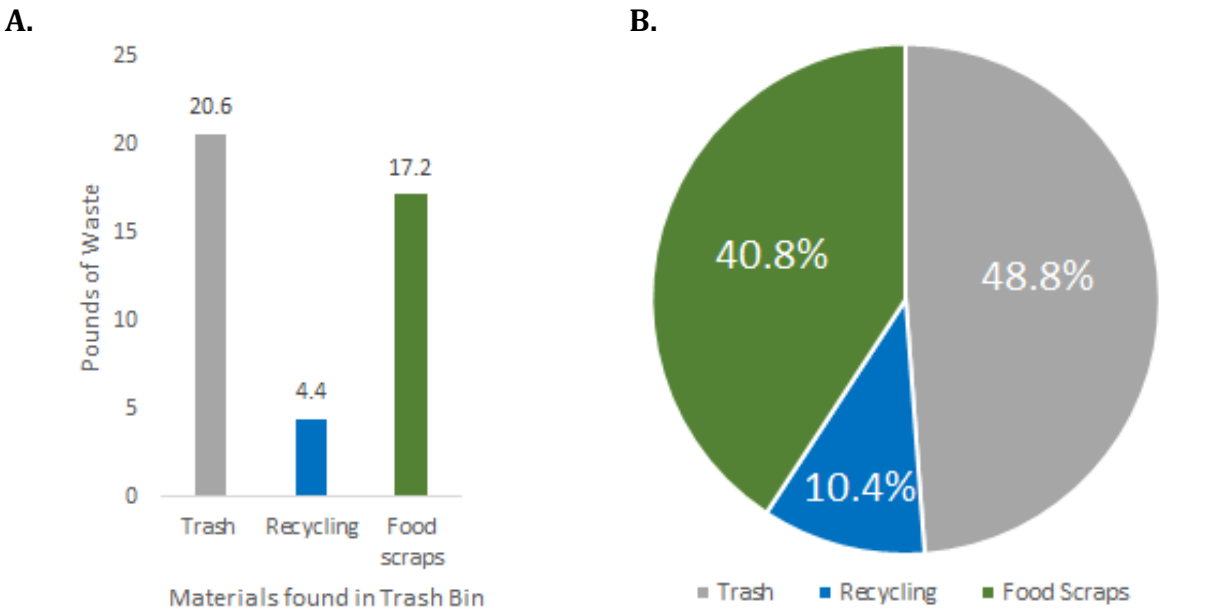

Figure 6: Waste found in trash bin in MUHS lunch spaces. Trash was gathered a day prior to sorting. Sorting occurred by dumping each bag of waste onto a large tarp, and each waste item was placed into the proper disposal category (trash, recycling, food scraps). A: Weight of each category of waste found within the trash bin. Total weight equaled 42.2 pounds. B: Percentages of each waste category found within the trash bin.

Educational Signage

In order to provide some help to students confused about what belongs in each bin, the sorting stations will be accompanied by educational signage. We approached the Student Senate and asked for their help in making these signs. Some members attended trash on the lawn and learned about the proper way to sort each type of waste, and brought this knowledge back to their peers. Using this experience and some informational material from the ACSWMD, the Senate is in the process of creating four sets of posters (See Figure 7). Each set will be hung above each bin detailing the types of waste that should be put in each, complete with physical examples and images from cafeteria lunches. These waste wrappers, containers, plastic cutlery, and other products were collected by the Senate members from their lunches and the lunches of their peers. Based on this participation, we expect that the student senate members will serve as leaders and experts about sorting lunchtime waste.

Figure 7: Preliminary posters for sorting stations created by the Student Senate. Students used real pieces of waste to help their peers quickly determine what type of waste should go into which bin.

Building of the Tables

To build the sorting tables, we worked with Ben Slater, the MUHS woodshop and design teacher. Mr. Slater was invaluable to our construction process. He worked through our design with us, fixing structural issues where needed. He also opened his woodshop to us, giving us access to many tools we could not have used without him.

We went into the shop to work for three mornings on construction. On the first morning, four student senate members came to the woodshop with us to help with the construction process. Not a lot was accomplished due to lack of supplies, as our materials order had not been completely placed yet. However, the students were able to help us cut the table legs to initiate the construction. This student involvement, however minimal, was important to the success of the tables because it allowed them to take ownership of the sorting stations. We hope that their contributions in creating the system will encourage

them and their peers to use it properly when sorting their waste. Additionally, we were able to address the woodshop students and engaged with them briefly to ask for help around the shop. Although we did not get to work directly with them, we hope that this exposure also has a positive impact on their relationship with the stations.

By the end of the third morning we completed two frames and made plans to go back during January to finish the other two. All four stations will be completed before the end of the first semester at MUHS, allowing stations to be in place and fully function by the start of the spring semester on January 23, 2018.

Recommendations for the Future

We believe it is imperative that the result of this project not simply be a 'quick fix,' but a result that leads to long lasting change. It was our mission to act as facilitators and

motivators in this process, not to provide the perfect solution. Therefore, we looked not only at the short term impacts of implementing a new physical infrastructure, but also at the existing and potential for connectivity, continuity, and integration of sustainability concepts and waste collection concerns within Middlebury Union Middle School and between the K-8 programs that feed into the school.

Currently, there is little communication between the Middle School, Elementary, and High School programs. There is no science club of any kind at the high school and few extracurricular opportunities for engagement with issues like food waste. It is not considered 'cool' to be green in the culture of the high school. How do we change this? There is much potential brimming under the surface. There are passionate members of the community at the all three school levels, there is a new infrastructure system in place, and students are engaging with topics in the little ways that they can, bringing great ideas to the table and coming at the issue with enthusiasm.

In order for a fundamental shift in thinking and behavior to occur at the high school engagement needs to continue, even in small sustained ways. We have had the privilege to work with the high school and middle school communities for a short time period. Therefore, we do not want to offer perfect solutions for the future as ultimatums for success, but rather as jumping off points. In the sections below, we outline suggestions and strategies for moving forward into the spring of 2018 and beyond. Some are ambitious and some are relatively simple.

1. **Increasing Connectivity and Supporting Continuity**
    a. *Long Term Habits:*

    Throughout this process, we have looked to the example set by Mary Hogan and MUMS in their pioneering of the table sorting system. While students at MUHS have not all gone through these two schools, many have. By establishing a waste sorting system that mirrors the stations in place at the elementary and middle schools, a system of continuity will be established. In the short term, high schoolers currently enrolled at MUHS will not have had the conditioning only brought by repeated use of the sorting stations. Starting in fall of 2018, however, the incoming class of freshman at MUHS that have come through MUMS will have two years experience with the same sorting system. Within the next four years, all students that have come though MUMS and entering MUHS will have been using the same sorting system and patterns of use will be established. Hopefully, proper use of the sorting stations will be second nature. It is easy being green when you do not even need to know that you are doing it (granted, engagement is the true end goal, though not all students will be reached this way and therefore societal conditioning fills those gaps in engagement).

In order for this system of continuity to thrive in the future, links need to be established between champions of food waste issues and greater environmental issues within each school to establish a network of support and continued communication about future developments, changes to the system, and/or future collaborations. While this may be difficult on an institutional level, we think it is important that contact is established on a more grassroots level, between teachers, club members, and community resources. While understanding the responsibilities that these actors already have, we think it is important that channels of contact remain open. Important contacts and resources are listed in Appendix G.

2. Curricular Integration: APES and Beyond

Opportunities for AP Environmental Studies Spring 2018 and Future

In the spring of 2018, the APES class will be studying a unit on waste and the environment. As part of this unit, we suggest that the issues involved in Act 148 be used as a local case study, with a tie-in to our project. We will be presenting to the students on our work and are encouraging a second Trash on The Lawn Day be conducted to evaluate change in the contamination of the waste streams after the rollout of the new sorting stations. Additionally there is opportunity to distribute the baseline survey after the new stations have been in place for a year in order to track changes and evaluate the project (Appendix A). APES students can take the lead on this issue within the school, and encourage their fellow students to engage with the issues behind why composting matters in Vermont. Armed with information about pollution from landfills, greenhouse gas emissions, nutrient cycles, decomposition, and the like, they can act as ambassadors to their friends and the broader school. With the transition to IB, students may be able to apply this activity toward an independent project in the future, or form a group that performs food waste related community service. The waste sorting project also serves as a small scale case study for several key IB Environmental Systems course aims, specifically local collaboration, the role of technology, and the different responses to environmental issues. Helpful resources are located in Appendix H.

Additional Integration

As we saw in the rollout of the new stations, there is potential for integration of waste and sustainability issues and projects into other elements of the curriculum besides the traditional environmental studies subjects of earth science, environmental science, biology, etc. as part of interdisciplinary work.

According to the IB Program, "students demonstrate interdisciplinary understanding when they bring together concepts, methods, or forms of communication from two or more disciplines or established areas of expertise so that they can explain a phenomenon, solve a problem, create a product, or raise a new question in ways that would have been unlikely through a single discipline" (Interdisciplinary Learning, 2017). For future development of the project, new grants may need to be written, providing English students the ability to craft a convincing argument, bridging the gap between science writing and argumentative writing. The issue of contamination before and after the implementation of the new stations is a math problem, a case study for how descriptive statistics can be used in science fields. Should food waste be a continued area interest, statistics can be used to track change over time.

We have been able to work with the woodshop in the building process of the physical sorting tables, bringing in yet another group of students. There is a great potential for the use of this project as a case study to go beyond the standard subjects one would associate it with. Environmental Studies and AP classes are self-selecting classes, and not all students in the school will be exposed to that environment. In the future, the IB program will require collaborative lesson planning. While we cannot compel engagement from students who have no interest in the project, introducing the issue into dialogue and materials will help to normalize the idea that everyone sorts their waste. Therefore, we are encouraging advocacy for including the food waste initiative into other subjects and lessons as teachers see fit. Helpful resources are located in Appendix H.

3. **MUHS School-Wide Collection Initiative**

Introduce Consistent Bin System

Although our project focussed primarily on the cafeteria and proximal collection sites, proper sorting of waste is an issue throughout the school. On our visits, we observed the system of bins currently in place in the hallways and classrooms. Bins are inconsistently colored, and labeled. In our conversations with Jac Hochreiter and from our research, it became clear that consistency is key. It is important to consider labeling, color coding, and position and frequency of bins. Humans are lazy. It is much easier to ingrain a three part sorting strategy if all three types of collection bins are grouped together and within spaces that the waste is produced. Therefore, we propose that all bins in the hallways be labeled with the same labels used on the cafeteria bins, and that bags be color coded in blue, green, and grayscale

for consistency to reinforce association. Trash, recycling, and food scrap collection should be grouped together where possible. Labels and photos of the current inconsistencies are located in Appendix E. All changes should be run by Sue and the rest of the custodial team, as they are the main actors and interact with this system every day.

Institute Classroom Compost Collection

Currently, the classroom system of recycling and trash collection is working well. It serves as a good example of what the future of food scrap collection at MUHS could be. In place at MUMS is a classroom food scrap collection service, run by the Compost Club at the school. Food scrap buckets can be obtained from ACSWMD (see Figure 7). We propose a similar system be put in place at MUHS. Collection details will be expanded on in the next section. A service such as this one may be eligible toward the service component of IB CAS requirements.

Figure 7: Example of a food scrap collection bucket. Source: The "Sure-Close" kitchen collector, 2015

4. **Science Club Compost Club Tie-In**

Potential for Working Together

We advocate for and support current sentiments at the school aimed at founding a science club, with some focus on environmental issues.. This space would provide students with an additional opportunity for engagement, scientific exploration, and to practice stewardship of the local environment. There is currently an active compost club at MUMS. Students involved in this group have shown active interest in continuing with similar projects once in high school. One of the club responsibilities is to collect and administer a classroom compost collection system. Students from this group would bring enthusiasm with them as they move into high school if a Science Club was in place. A goal of the club in the future could be to institute a similar composting system at the high school. Additionally, this club could provide mentorship opportunities for students if MUMS students were invited to participate while MUHS students lead the club activities.

5. **Beyond Paper: Reducing Confusing Packaging in the Cafeteria**

Student Ideas Initiative

Over the course of this project, we have had the opportunity to talk to students at the high school about the issues they have observed in the current waste sorting system and they have offered some ideas of their own on how to reduce waste and make sorting waste easier for students. An idea that has cropped up multiple times is to reduce the amount of waste being produced by student lunches. For example, the paper trays used to serve cafeteria lunches cannot be recycled afterward and do not compost. Plastic forks, spoons, and knives are confusing for students and cannot be recycled. Aluminum foil is recyclable, but the aluminum and paper wrapping used for hot meals is not recyclable. Why not stop some of the waste before it happens? Students proposed to us that the cafeteria at the high school look into ways that they can reduce waste on the other end. We propose that the student Senate take on this issue and talk with cafeteria managers and employees to get their opinion on the subject and to push for change. Additionally, we would like to see the student Senate or other groups of students brainstorm ideas for going forward, reducing waste, and for ways to improve our new system as the student body becomes more accustomed to it.

Conclusion

As of the release of this report, the stations are nearing completion and await their introduction to the MUHS cafeteria in the coming spring semester (January 2018). The stations incorporate design elements from the MUMS station and from our research into critical design theory. Two table frames have been completed, one of which can be seen in Figure 8.

The design of our proposed new waste sorting systems includes only three bins per station–one each for food scraps, recyclables, and landfill waste–each clearly labeled with a poster showing common lunchtime waste items and which bin they belong. . By clearly differentiating each bin and waste stream, the user's choice of where to put their waste becomes vastly simpler. We also plan to put the landfill waste bin in the middle of the three so that it is not the bin that users arrive at first when approaching the station.

Figure 8: Completed frame of new MUHS sorting system as of December 2017

The efficacy of this design strategy is supported by research concerning the impacts that the partitioning of options and attributes can have on choice. The way in which a set of options–in our case, the array of bins in each waste sorting station–is presented one of the most important facets of choice architecture: "Prior research in diverse domains has shown that partitioning creates vivid categories that can influence allocations involving simultaneous choices" (Johnson et al., 2012). The design of the new stations takes these ideas into account. Users of the new stations will have only three bins to choose from, as opposed to nine under the previous system. As previously mentioned, each of these three bins will be clearly partitioned based on appropriate waste type. In addition, each of these bins will be accompanied by a decision aid in the form of a poster clearly demonstrating which types of waste should go in each (See Figure 7).

These new stations will be clear and easy to use, continue the precedent set at the middle school, and result in long term change at the high school if they are maintained and become integrated into the routine of the school. Using the stations will become second nature. While diversion rates should improve with the roll-out and use of the new stations, the project does not end here. Continuing educational integration, raising general

awareness of sustainability issues, and proposed new initiatives will carry the mission forward. Hopefully, the benchmark survey will be repeated and show improvement. If the enthusiasm of the composting club students at the middle school tells us anything, it is that waste issues will continue to be important to the student body. We are hopeful about the future of the project and the school meeting diversion rates by 2020.

Reflections

An important takeaway from this process has been that a project is not simply assessed by the tangible results produced at its completion. Often, intangible changes and learning experiences provide equally valuable results towards achieving the main goals. This was evident in our project, as the physical changes to MUHS represent an important part of our outcomes but do not encompass the full extent of what we accomplished and learned along the way. We have come away from this project with two main learning experiences that will prove incredibly useful going forward. First, tailoring your communication style to fit with the partner organization and getting boots on the ground was essential to the success of the project. A community based project often has many moving parts and people making navigating it from the outside a challenge at times. We had a huge learning curve and found the effectiveness of face-to-face communication crucial to making progress and achieving our goals. Second, small local projects will not succeed without really dedicated actors or "champions" to push all the players forward and provide the needed motivation and enthusiasm. We were lucky to have some eager students and amazing teachers and mentors to help us out throughout the semester.

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